Annealing Silicon Nanoparticles to Increase T1 in Medical Imaging

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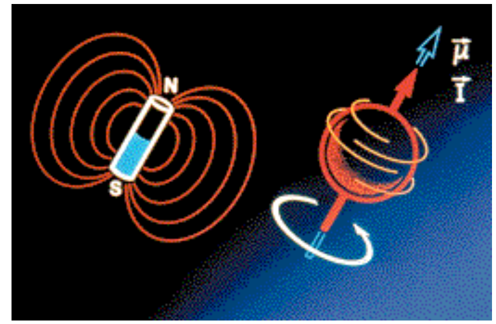
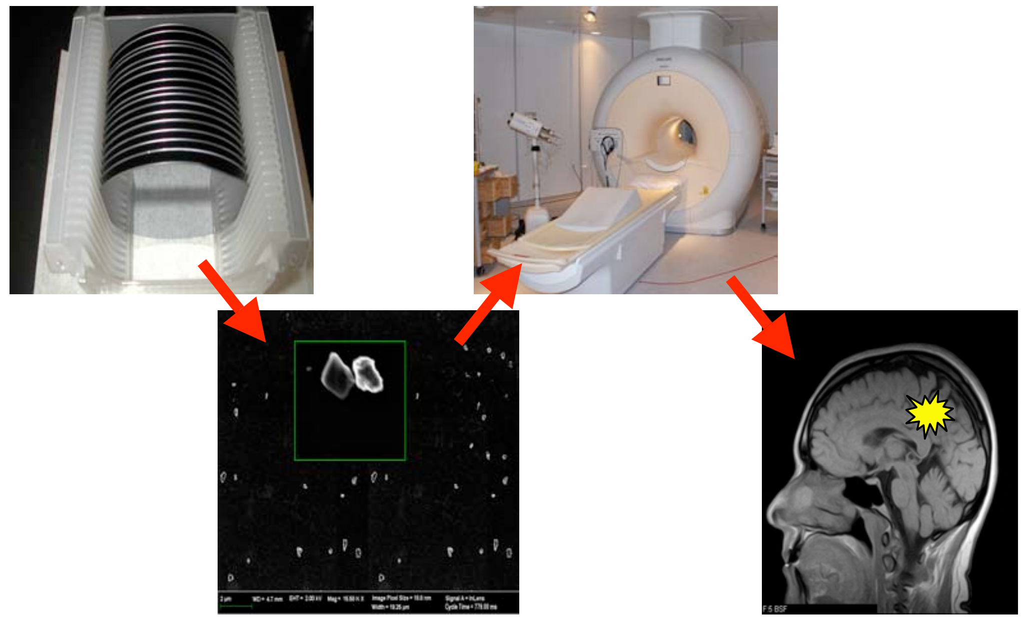
Magnetic Resonance Imaging (MRI) allows protons (in water) in the body to be visualized noninvasively. Silicon nanoparticles have nuclear spins (^{29}Si) that can also be imaged. The added advantages are that there is no other silicon in the body to create background noise and the nanoparticles can be directed and tracked to a specific part of the body.

Image contrast of conventional MRI depends on large magnets to align proton spins much like a bar magnet aligns with the earth's magnetic field. During imaging, spins are tipped and the time it takes to recover from the tip, called T1, affects image quality. In silicon nanoparticle-based MRI, the particles are polarized before being put in the body, and so large fields and thus large magnets are not needed. The length of time that imaging is possible is dependent on the nuclear T1 of the ^{29}Si atoms.

Long-T1 nanoparticles were fabricated using ball-milling of high-resistivity wafers. We subsequently aimed to minimize trapped electric charges and defects by annealing (rapid heating) at ~400°C in hydrogen gas.

Supported by NSF EEC-0649215





- Silicon's nuclei can be polarized like a bar magnet in a strong magnetic field.
- We make silicon nanoparticles that could be used as MRI agents by grinding silicon wafers for 12-30 hours.